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WORK ON APPLICATION OF RADIOISOTOPES
BY THE CENTRAL ROENTGENO-RADIOLOGICAL INSTITUTE

[Comment: The following article, "Practical Application of Radioactive Isotopes" by Prof M. Pobedinskiy, director of the Central Roentgeno-Radiological Institute, Ministry of Health USSR, appeared in Meditinskiy Rabotnik, Vol 18, No 29, Moscow, 1 April 1955.]

Considerable experience has already been accumulated in medicine on the application of natural radioactive elements, which in addition to X rays are used with a great measure of success in the therapy of malignant neoplasms. Natural and artificially prepared water containing the radioactive gas radon is also used for therapeutic purposes. This type of balneotherapy yields good results in the treatment of many diseases of the nerve system and cardiovascular system, of diseases of the bones and joints, of disturbances of metabolism, of skin diseases, and of diseases of the female genital organs.

Extensive introduction into practical medicine of natural radioactive elements was made difficult by the fact that these elements are produced in inadequate quantities. Consequently, only a small number of medical institutions could use them. The work in the field of medical radiology by our native scientists P. G. Mezernitskiy, E. F. Reshetillo, V. A. Polubinskiy, N. N. Petrov, and many others formed a valuable contribution to the development of this branch of science.

In 1934, Frederick Joliot-Curie together with Irene Curie found a method of preparing artificial radioactive isotopes. This was one of the most important discoveries made in the first half of the 20th Century.

A great contribution to the study of isotopes has been made by our Russian scientists, i.e., A. M. Butlerov, who predicted their existence in 1881, and D. I. Mendeleev, who indicated the path along which investigations of the problem concerning the structure of matter must proceed. By 1930 the Soviet scientist V. G. Khlopin published a number of papers on the properties and practical applications of artificial radioactive substances.

The problem of measuring the intensity of the radiation emitted by radioactive isotopes has already been investigated thoroughly. Such measurements are carried out by counters or electroscopes.

Beginning in 1936, radioisotopes, particularly radioactive phosphorus, have been applied in the treatment of patients suffering from erythremia, chronic lymphatic and myeloid leukemia, lymphosarcoma, and other diseases.

Depending on their chemical properties, different radioactive isotopes accumulate selectively and preferentially in different organs and tissues when introduced into the organism. Phosphorus is deposited preferentially in the bones and, in cases of leukemia, also in the pathologically changed lymphoid tissue; strontium, predominantly in the bones; and radioactive iodine, predominantly in the thyroid gland.

Among all radioisotopes, radioactive phosphorus is the most common. At recent conferences conducted at the Central Roentgeno-Radiological Institute of the Ministry of Health USSR (Leningrad), some results on the application of radioactive isotopes for therapeutic purposes were summarized. At one conference the effectiveness of the therapy of diseases of the blood formation organs with radioactive phosphorus was indicated in papers given by M. P. Domshlak, S. A. Rayevskaya, U. G. Grigor'yeva, V. D. Selokhova, Ya. N. Mozharova, Z. T. Belugina, N. V. Ratmirova and others.

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Mozharova and Belugina had observed ten patients suffering from erythremia, nine patients suffering from myelosis, and nine patients suffering from chronic lymphadenosis. All these patients were treated with radioactive phosphorus administered perorally. The intervals between the individual administrations were 3-15 days. Good results accompanied by the restoration of the peripheral blood to normal were obtained in the treatment of eight cases of erythremia. In six of these cases, recovery persisted for 6 months.

In five cases of myelosis an immediate beneficial effect was noted after the treatment. Relapses after 6 months were observed in this group in two cases. Out of nine cases of lymphadenosis, a beneficial effect was obtained in five cases.

The results of observations by various researchers indicate the advisability of developing further the method of therapy with radioactive phosphorus in leukoses and erythremias, because this type of treatment has a definite therapeutic value and does not have an unfavorable effect on the patients.

Scientific Associate N. V. Nikolayeva has applied the therapy with radioactive phosphorus in cases of erythremia. She combined this method with other measures: at intervals of 5 days the patients were subjected to bleeding. After 450-500 milliliters blood had been extracted, 300-400 milliliters of fresh plasma were injected. Following this, radioactive phosphorus was administered parenterally every 4-5 days. The radioactive phosphorus administered was contained in a 10 percent solution of glucose diluted to a volume of 100 cubic centimeters. By this treatment, there was a gradual reduction of the level of hemoglobin and of the quantity of erythrocytes until a normal condition of the blood resulted. Considerable improvement in the general condition of the patients took place. Irritability and headaches were reduced.

Twenty patients were subjected to observation for 2 years. Only one showed a relapse, which occurred 14 months after the treatment.

Radioactive phosphorus was also used for the treatment of patients suffering from lymphosarcoma. In literature, several cases are described which responded to treatment with this method. The general condition of the patients improved. The swollen lymph nodes were diminished in size and in some cases were reduced to normal size. In individual cases complete recovery was achieved.

The application of radioactive iodine in the treatment of metastases of cancer of the thyroid gland was also investigated. The best effect in this type of treatment is achieved when the thyroid gland is extirpated following the administration of radioactive iodine. The quantity of radioactive iodine resorbed by the metastases was found to increase as a result of the extirpation of the gland. To achieve an accumulation of radioactive iodine in the tumor, the thyrotropic hormone is sometimes administered.

Almost all investigators who have applied radioactive isotopes point out that radiation sickness is almost never observed after introduction of the isotopes into the body. However, radiation sickness frequently takes place as a result of therapy with X rays. The complications which follow treatment with radioactive isotopes are mostly due to the action of these isotopes on the organs of hemopoiesis.

Only isotopes the half-life of which does not exceed 10-15 days may be introduced into the body.

At our institute we have investigated especially problems of the application of beta rays emitted by radioactive phosphorus in the treatment of skin diseases and also problems arising from the physical properties of radioisotopes

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used as a source of beta rays for the external irradiation of the organism (V. A. Petrov). In the course of this work we studied the reactions of the organism in response to the external action of beta rays (L. V. Funshteyn, et al) and the methods of using radioactive phosphorus for the therapy of a number of diseases of the skin (A. V. Kozlova, K. P. Nartsissova, A. Ye. Khalyavin, A. S. Bezzabotnov, and others).

The greatest advantage connected with the use of beta rays as compared with X rays and gamma rays is absorption of the radiation in the surface layer of the skin combined with a considerably weaker effect on the general state of the organism. Furthermore, beta radiation emitted by radioactive phosphorus can be used for skin diseases without special equipment and even when electric power is not available. The application of beta radiation emitted by radioactive phosphorus can be recommended for the treatment of capillary angiomas, restricted types of eczema, neurodermitis, suppurative diseases, and other dermatoses. In eczema and neurodermitis the prolonged use (during a month) of radiation in doses exceeding 600 roentgens is not advisable. In the therapy of capillary angioma the skin reaction in its form and intensity must not go beyond the manifestations of a dry epidermitis.

Extensive use of radioactive cobalt for the treatment of malignant tumors has been started at our therapeutic institutions. Interesting and very instructive data have been accumulated at our institute. V. G. Garasimyak, Scientific Associate at the Central Scientific Research Roentgeno-Radiological Institute, has developed a method of treating cancer of the skin with radioactive cobalt. She subjected 78 patients to observation. Of these, 72 had malignant tumors of the skin of the head. Cancer affecting the basal cells of the skin was observed more often than the other types. The results obtained by treatment with radioactive cobalt were as follows:

An immediate beneficial effect was observed in 69 cases. On completion of the treatment, 56 patients were observed for one year. A recurrence took place in only five cases.

On the basis of her observations, V. G. Garasimyak concluded that needles charged with radioactive cobalt may replace needles filled with radium-mesothorium as far as their effectiveness is concerned and that treatment of the cancer of the skin of the third and fourth stages is best carried out by means of teleradium equipment.

A. V. Kantin treated with needles containing radioactive cobalt 30 patients who had cancer of the lower lip affecting the squamous cells. The total dose of radiation that was applied amounted to 5,000-7,000 roentgens while the magnitude of the doses was 25-35 roentgens per hour. This researcher carried out microscopic examinations of the tumor during the treatment and compared the data obtained with the results of analogous observations on patients treated by the intratissue method of irradiation. In the intratissue method of treatment needles charged with radon were used.

On the basis of these investigations the similarity of the clinical and microscopic aspects in both methods of treatment was established. As a result of this comparison, it appeared advisable to substitute treatment with radioactive cobalt for the treatment with radon.

M. A. Volkova has collected data on teleradium therapy with radioactive cobalt and with radium-mesothorium. On treatment with radioactive cobalt of patients suffering from skin cancer and cancer of the lower lip, an immediate beneficial effect was observed in 83 percent of the cases while such an effect was produced by treatment with radium-mesothorium in only 73 percent of the cases. On treatment of malignant tumors of the pharyngeal ring (Waldeyer's tonsillar ring?) a directly effected cure was observed in 70 percent of the cases when radioactive cobalt was used, while a similar cure resulted in only 61 percent of the cases when treatment with radium-mesothorium was applied.

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K. N. Chochia applied teleradium therapy with radioactive cobalt on 60 patients suffering from cancer of the throat. In 33 of the patients thus treated, no symptoms of cancer were present on completion of the treatment.

By means of a teleradium apparatus M. A. Volkova treated 74 patients suffering from cancer of the throat. In 71 cases she observed a beneficial effect immediately after completing the course of therapy. On the basis of further observation of these patients during a 2-year period, 57 of them were found to be completely cured. Ye. M. Shvartsberg observed the results of treatment with radioactive cobalt of 30 patients suffering from cancer of the urinary bladder. Improvement took place in 26 of these cases. After penetrating X-ray therapy had been applied to 21 other patients suffering from the same condition, improvement was observed in only 12 cases.

On the basis of their observations, the above-mentioned researchers concluded that radiation sickness is encountered more seldom and is less pronounced after treatment with radioactive cobalt than after application of X-ray therapy. Teleradium therapy also has the advantage over X-ray therapy in that it brings about a more rapid regression of the afflicted lymph nodes.

L. M. Stukova has applied radioactive cobalt in the treatment of 63 patients with inflammatory diseases (panaritium, furunculosis, carbuncles, paronychia, phlegmons, and hydroadenitis) and obtained favorable results which were not inferior to those achieved by means of X-ray therapy. A. Ye. Khalyavin treated 20 patients who had radiculitis and ischias by using a short-focus apparatus charged with radioactive cobalt. The distance from the cobalt to the skin was 3 cm. The ischiolumbar region was irradiated in two fields. The dose applied in each field was 100 roentgens. The total dose applied was 400-600 roentgens. After completions of the course of treatment there was recovery in 6 cases and improvement in 13 cases.

The introduction of therapy with radioisotopes into the practical work of oncological institutions has made possible successful treatment of malignant tumors by means of combined methods which involve irradiation.

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